R

rationality The chaotic history of human affairs may incite scepticism about the traditional definition of our species as the 'rational animal'. But possession of the implied capacity for correct reasoning, effective deliberation, and judicious planning does not entail that it is always exercised. The characterization can be safely endorsed if we take 'rational' in a categorical rather than an evaluative sense. In the categorical sense, the term includes contrasts with 'arational', and includes both rationality and *irrationality. In the evaluative sense, we can distinguish three domains. Two of these, epistemic and practical or strategic rationality, have been extensively studied. A third, axiological rationality, is most pertinent to emotions but remains underexplored.

Both epistemic and strategic rationality embody a common idea, namely the quest for ways to maximize the probability of success in enterprises that aim at different sets of *goals. Strategic rationality seeks the best ways of attaining practical goals, while epistemic rationality aims at truth, the avoidance of falsehood, and other epistemic values such as explanatory power (see BOUNDED RATIONALITY). Deductive rationality is the object of logic: it identifies forms of inference guaranteed to preserve truth and consistency. Inductive rationality, as David Hume (1711–76) pointed out, affords no such guarantee since no logical rule could warrant the reliability of inferences from past to future observations (Hume 1888/1978). Inductive rationality therefore aims not at certainty but at maximizing the likelihood of correctness. Despite some unconvincing carpings from post-modernist sceptics and relativists, the consensus is that the theory of rationality ultimately merges with the complexities of scientific method (Brown 2001). Complications, however, beset the relation between epistemic and strategic rationality. Maximizing true belief is not logically equivalent to avoiding false ones. The need to balance these two epistemic aims, as well as other considerations arising from a pragmatic view of truth, supports a strategic view of epistemic rationality itself (Levi 1967). Furthermore, epistemic rationality can conflict directly with strategic rationality. A notorious example is Blaise Pascal's (1623–62) wager: assuming a possibility of infinite gain or loss, belief in God might be the better strategic choice despite its extreme improbability. Those complications highlight the problem of whether the choice of goals can itself be subject to rational principles. Aristotle (382–322 BC) seems to have thought that choice of goals should be brought under the aegis of *phronesis* (a species of rationality usually rendered as 'practical wisdom') (Aristotle 1984, 1144b14–17). Hume, on the contrary, notoriously thought that reason could only be the 'slave of the passions' (Hume 1888/1978, 2.3.3.4)).

One crucial role of emotions in rationality is therefore that of defining the goals of action, to which reason then calculates the means. Emotions are thus directly pertinent to the third domain of axiological rationality, so named after the Greek word for value. In that perspective, emotions are perceptions of *values, or at least normative responses to values (Tappolet 2000). Although the principles of axiological rationality—that domain of rationality which assesses appropriateness of emotions and attitudes—remain obscure, it may be that it alone can arbitrate in those cases where epistemic and strategic rationality conflict.

R. DE SOUSA

Longino, H. (2006). The social dimensions of scientific knowledge. In: E.N. Zalta (ed.), *Stanford encyclopedia of philosophy*, Fall 2006 edn (http://plato.stanford.edu/archives/fall2006/entries/scientific-knowledge-social/).

de Sousa, R. (1987). *The rationality of emotion*. Cambridge, MA: MIT Press.

reappraisal Reappraisal is a cognitive form of emotion regulation (see regulation of emotion). It involves altering the meaning of a situation so that the emotional response to that situation is changed. Reappraisal may be used to increase, decrease, or qualitatively change an emotional response, although it is perhaps most frequently used to decrease negative emotion.

Interest in reappraisal dates back thousands of years to philosophers such as the Stoics, who emphasized that the way we think determines the emotions we have (see STOICISM). Within psychology, the notion of reappraisal is linked to *appraisal theory, which holds that our evaluation (or appraisal) of a situation—rather than the situation itself—determines our emotional response. Reappraisal also is a key element in *cognitive behavioural therapy, where maladaptive appraisals are altered in order to decrease negative emotion.

reason

Empirical support for the idea that reappraisal can alter our emotions is provided by modern studies of reappraisal. Often, these studies involve eliciting negative emotions in the laboratory using slides or films and then asking participants to think about the stimulus from the perspective of a detached observer. Findings from such studies indicate that reappraisal decreases explicit (e.g. self-reports, behaviour) and implicit (e.g. startle responses) indicators of emotion (Gross 2002). Using functional magnetic resonance imaging (fMRI), researchers have found that regions of the prefrontal and *anterior cingulate cortices—implicated in cognitive control—show increased activation during reappraisal, whereas brain regions associated with emotion generation, such as the *amygdala and insula, show decreased activation (Ochsner *et al*. 2004). Researchers are currently investigating the role that reappraisal plays in normal and abnormal functioning. The evidence to date suggests that reappraisal can be an effective strategy for regulating the experiential, physiological, and neural responses to emotional situations.

NICOLE R. GIULIANI AND JAMES J. GROSS

reason Our ordinary language can lead to a general confusion of two different uses of the term 'reason', and this is relevant when considering emotion. Although the uses are not the same, they are connected. One use concerns a person's *subjective* reason, the reason which justifies from the point of view of the agent. For example, if Peter ran away from Paul, he might explain his action by saying that he was afraid of Paul, and he was afraid because he thought he was being threatened by Paul. But there is another sense of reason, namely *objective* reason, in which we might say that Peter had *no* reason to be afraid of Paul, and thus no reason (no *good* reason) to run away from him, simply because, in fact, Paul was not threatening him. Empirical psychology is generally only concerned with subjective reasons. Ethics is concerned with both subjective and objective reasons.

PETER GOLDIE

Dancy, J. (2000). *Practical reality*. Oxford: Oxford University Press.

recognition of emotion (neural systems for) Charles Darwin (1809–82) highlighted one aspect of emotions that is prominent in mammals, especially primates: their social communication (see INTERPERSONAL COMMUNICATION). We infer how other people feel by observing their face and their gestures, and by listening to their tone of voice (see VOCAL EXPRESSION OF EMOTION). Such expressions are often regulated by cultural *display rules; sometimes they can be deceptive and used to manipulate others—at least in adult humans. Given this complexity of possible expressions it is not surprising to find complexity in recognition as well. A baby's smile evokes an immediate sense of joy in the viewer; a posed smile can be cognitively matched to the label 'happy'; and the complex, fleeting, and highly regulated emotions we typically see on the faces of those around us often require for their recognition a mixture of empathic response, cognitive deduction, and inferences that take into account the person and their situation.

What happens in the brain when we recognize emotions? The psychological complexity notwithstanding, findings from cognitive neuroscience have begun to shed some light on this question, and have begun to inform psychological models in the process. In prosopagnosia, often following bilateral damage to occipitotemporal cortex, recognition of the identity of a face (who the person is) can be impaired yet recognition of the emotion (how they are feeling) remains largely intact. Conversely, bilateral damage to the *amygdala impairs recognition of the emotion but leaves recognition of identity intact. Double dissociations such as these suggest that information about the emotional expression of a face is processed differently by the brain, and by somewhat separate regions, than is information about its identity. These data are consistent with earlier models of face processing that cleanly separated identity and emotion processing, although current models argue for a more sophisticated view in which identity recognition and emotion recognition arise from partly different combinations of more abstract underlying component processes (Calder and Young 2005).

What is 'recognition'?

Detection and discrimination of emotions (e.g. judging whether two simultaneous facial expressions are the same or different) depends on sensory cortices, and can occur without recognition or naming (as in category-specific agnosias). Perception of faces involves processing of their static configuration, which draws on cortex in the fusiform gyrus, and processing of their dynamic changes, which draws on cortex in the superior temporal gyrus and sulcus. These regions are most important for perception related to identity and expression, respectively (see Fig. 1) (Haxby *et al*. 2000). In monkeys, cells have been recorded near these regions that respond best to faces as stimuli.

Recognition requires more than just basic perception; it requires association of a perceptual representation of the stimulus with its meaning (with some kind of memory). The simplest form of recognition is re-identification of a previously seen stimulus. More commonly, recognition involves matching a stimulus onto a category—for instance, recognizing that a given facial expression shows happiness. There is some evidence that facial expressions show categorical perception: they can-

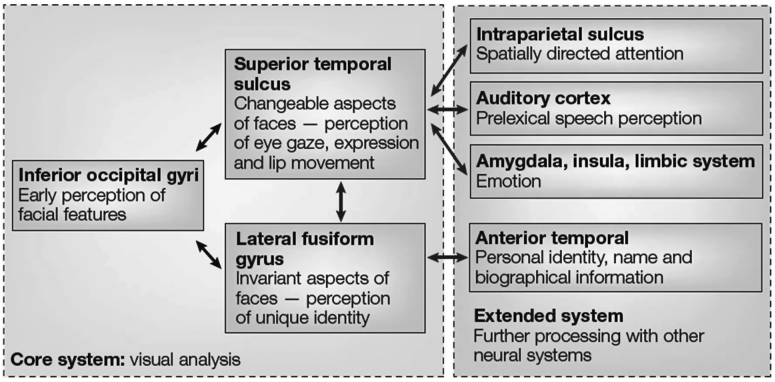

Fig. 1. Processing of faces begins with early feature perception in occipital cortices, and then proceeds via multiple, parallel streams that decode different kinds of information. From Haxby *et al*. (2000), reproduced in Calder and Young (2005).

not be discriminated any more accurately than they can be recognized (Young *et al*. 1997). In real life, recognition usually involves generating many other inferences as well—such as judging what the relevance and importance of the emotion is, and what it is that oneself should do in response to it.

What are the 'emotions'?

The interpretation of performance on emotion recognition tasks is limited by the list of possible emotion categories provided as response options. Typically, subjects are provided with a list of word labels, such as the list of *basic emotions (*happiness, *surprise, *fear, *anger, *disgust, *sadness) and asked to choose the label that best matches the emotion shown in the stimulus. If the stimuli are selected so that most subjects agree on their emotion labels, this can be a relatively straightforward way to measure emotion recognition. The pattern of errors (confusions) produced can be informative as well, as some patients may consistently mistake one emotion for another, whereas others may simply produce the same confusions as normal subjects, only more of them (e.g. confusing surprise with fear, or confusing anger with disgust). Yet it seems likely that most, if not all, brain structures participate in emotion recognition in more abstract ways that do not map cleanly onto our preconceived emotion categories. For instance, the amygdala has been hypothesized to be important for recognizing fear, for processing most facial expressions, or for processing related to any highly relevant, salient, or ambiguous expressions.

Other tasks ask subjects to rate the intensity of different emotions expressed by a stimulus, or ask them to make similarity judgements between two stimuli. Data from such tasks have shown that the similarity structure of the emotion categories that are commonly recognized shows certain regularities. For instance, surprise and happiness are judged to be more similar to one another than are sadness and happiness. Some psychological theories have taken such data to support dimensional theories of emotion (such as a two-dimensional space of valence and arousal), and some kinds of brain damage show disproportionate impairments along certain dimensions in this space (see DIMENSIONAL MODELS).

Recognition of 'basic' emotions

The evidence that a particular brain structure is important for the recognition of a particular emotion is clearest for two basic emotions. Fear recognition can be disproportionately impaired by damage to the amygdala. Disgust recognition can be impaired by damage to the insula, the basal ganglia, or in Huntington's disease (a genetic neurodegenerative disease that preferentially damages cells in the basal ganglia early in its course) (Calder *et al*. 2001). Yet in both cases, the dependency is not absolute (there are cases of patients with damage to these structures whose recognition is relatively intact) and not completely specific (there are usually also impairments in the recognition of other emotions, and activation in imaging studies showing complex patterns across all emotions (Fitzgerald *et al*. 2006)). The amygdala is known to be involved in a variety of processing related to fear, such as Pavlovian fear conditioning, and appears to be important for recognizing fear from faces as well as perhaps other cues, such as body postures and tone of voice (although the evidence is most clear for faces). Responses of the amygdala to emotional faces are modulated by the context in which the face occurs, and by the direction of eye gaze in the face (Adams *et al*. 2003). The insula is known to be involved in processing

interoceptive information, including taste and nausea, and appears to be important for recognizing disgust from all stimuli, including facial expressions.

Across lesion studies, and especially across neuroimaging studies, it is generally clear that emotion recognition draws on a quite distributed set of brain structures, as is the case for emotion experience. Moreover, there are probably strong individual differences, and effects of gender (Wager *et al.* 2003). Recognition of happiness appears to be least susceptible to brain damage, whereas recognition of negatively valenced emotions is more easily impaired. One reason for this finding may be that there are more negative than positive emotion categories, and so distinguishing among the negative ones is just more difficult because it requires more subordinate-level categorization (Adolphs 2002).

Lesion data suggest that structures in the right hemisphere are more important for emotion recognition than structures in the left hemisphere, although this is less well supported by neuroimaging studies. The story is also complicated by the finding that right-hemisphere lesions may disproportionately impair the recognition of negatively valenced emotions, or of highly arousing emotions. Lesion studies have suggested that right somatosensory cortices, including insula and supramarginal gyrus, are especially important for recognizing emotion from faces (Adolphs *et al.* 2000), whereas right premotor and prefrontal cortices may be most important for recognizing emotion from prosody (Adolphs *et al.* 2002). Other studies have found activation of the right middle superior temporal sulcus in response to angry prosody in voice stimuli (Grandjean *et al.* 2005), and there is evidence that parts of the right prefrontal cortex may also be most engaged by stimuli that signal anger.

Social emotions and theory of mind

*Social emotions include those focused on the *self (such as *embarrassment, *guilt, *pride, and *shame) and those focused on the fortunes of others (such as *empathy, *envy, and *schadenfreude). Much less is known about the neural substrates for recognizing these emotions, and they usually require more complex cues and context in order to be recognized (they are difficult to recognize from facial expressions alone). Some imaging and lesion studies suggest that medial prefrontal cortices are especially important for recognizing these emotions (Shamay-Tsoory *et al.*, 2007), perhaps because these regions of the brain are necessary for reasoning about minds more generally.

'Theory of mind' refers to the ability to conceive of mental states, which are inferred from observed behaviour (see THEORY OF MIND AND EMOTION). There are debates about whether nonhuman primates have a theory of mind, and about the age at which it arises in human development. Theory of mind appears to draw on medial frontal and inferior parietal cortex, among other structures, and is important for attributing thoughts, intentions, and complex mental states to others, in addition to social emotions. It is impaired in people with *autism, who also have difficulty judging social emotions from faces, especially from the eye region.

Mechanisms behind emotion recognition

Some emotion recognition tasks can be performed simply with a combination of normal perception, semantic knowledge, and reasoning: for instance, deducing that a smiling face signals happiness. Others that require more subtle judgements, or that require judgements on the basis of cues that are not so obvious, may rely on simulating aspects of the emotion in the viewer. The theory that simulation and empathy play a role in emotion recognition has received considerable attention, and is in line with the observation that impairments in the ability to experience emotions often correlate with impairments in the ability to recognize them in others (Goldman and Sripada 2005). One structure important for experience, recognition, and empathy is the insula, an interoceptive somatosensory cortex activated by pain, anger, empathy, and disgust (see Fig. 2). A recent study found that the perceived sadness of faces was enhanced by large pupils, involved an empathic pupillary response in the viewer, and activated the insula (Harrison *et al.* 2006).

It would seem important for the brain to be able to extract some information about the emotional meaning of certain cues very rapidly when they can be related to life-and-death situations—such as wide eyes signalling fear, or bared teeth signaling anger, for instance. There is evidence for rapid processing of emotional expressions via subcortical routes to the amygdala, and there is evidence that the amygdala can be engaged, and emotional responses evoked in the viewer, even for stimuli that are presented subliminally (Jiang and He 2006). Subcortical processing proceeds via the superior colliculus and pulvinar thalamus. Such processing may underlie attentional 'pop-out effects in visual search for certain facial expressions, such as anger. However, it falls short of what we normally call 'recognition, but may be an accompaniment of normal recognition and may help to guide slower cognitive processing by providing an immediate bias (see ATTENTION AND EMOTION). Subcortical processing routes may also be the predominant mode of face processing available to many other animals, especially nonmammals, and the predominant mode available early in human development (Johnson 2005).

Finally, it is of interest to ask what it is about an emotional expression that allows the brain to decode

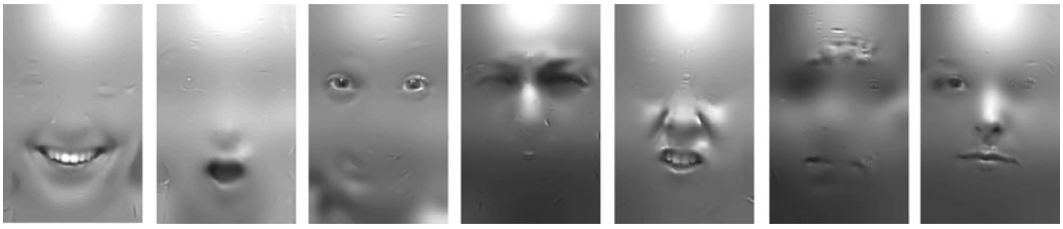

Fig. 2. Some of the brain regions important for recognizing emotions. Arrows show the predominant feedforward flow of information, but there are known feedback connections as well. Rapid subcortical information about faces can reach the amygdala (A) via the superior colliculus (SC) and provide a bias for emotion recognition, even for stimuli that cannot be consciously perceived. Cortical input to the amygdala is conveyed via early visual cortex (EV) and then regions in the fusiform gyrus (FG) and superior temporal sulcus and gyrus (STS); such information is also conveyed to regions of medial prefrontal cortex (mPF), which is connected with the amygdala. The amygdala and medial prefrontal cortex can trigger emotional responses to stimuli. Regions involved in empathy and simulation, and important for emotion recognition, at least in the right hemisphere, are somatosensory cortex (SS) and insula (INS). Most of the structures indicated are situated deep in the brain and would not be visible on the surface view shown here. Modified from Adolphs (2002).

the emotion. Responses in the brain to faces or voices have been found to decode emotion from complex configurations of stimulus cues that are not reducible to a single feature. Certain spectrotemporal components of the voice or of music signal emotional information, and certain feature configurations in faces are used to distinguish among different emotions (see Fig. 3). Recent studies have extracted the cues from faces that signal basic emotions, and have found that the amygdala is most important for processing information about the eyes, which distinguish fear from the other basic emotions. A patient with lesions of the amygdala was found to be impaired in fear recognition because she failed to fixate and process the eye region of facial expressions (Adolphs *et al*. 2005a).

Summary

(1) Many brain structures participate in recognizing any emotion. (2) Emotion recognition is always relative to the task used and the emotions presumed to exist. (3) Recognition of fear and disgust relies substantially on the amygdala and the insula, respectively. (4) Simulation may be one important mechanism for recognizing emotions.

RALPH ADOLPHS

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Harrison, N.A., Singer, T., and Rothstein, P. (2006). Pupillary contagion: central mechanisms engaged in sadness processing. *Social Cognitive and Affective Neuroscience*, **1**, 5–17. A study

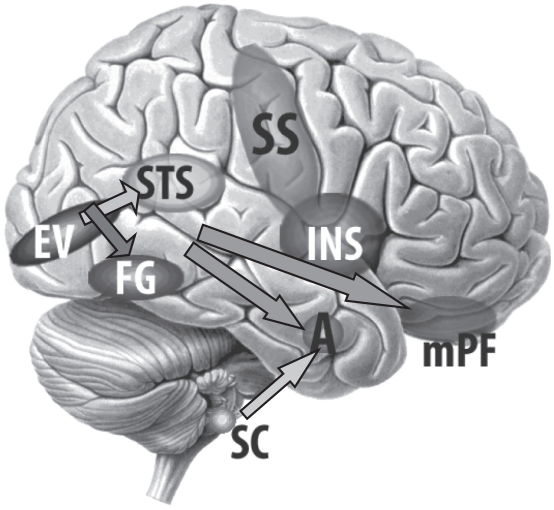

Fig. 3. Features in facial expressions that distinguish the different basic emotions. By showing viewers small, randomly sampled pieces of faces, it was possible to extract which features are the most effective in allowing them to discriminate between different emotions. The classification images shown in the figure show the regions of the face that, when revealed, are most effective in allowing viewers to discriminate that emotion from all the other basic emotions. From left to right: happiness, surprise, fear, anger, disgust, sadness, neutral. Note that the eyes are most important for distinguishing fear. From M.L. Smith *et al*. (2005).

showing that empathic pupillary responses in the viewer influence recognition of emotion, and providing evidence for the role of simulation in emotion recognition.

Adolphs, R., Gosselin, F., Buchanan, T.W., Tranel, D., Schyns, P., and Damasio, A.R. (2005). A mechanism for impaired fear recognition after amygdala damage. *Nature*, **433**, 68–72. A study showing that the amygdala impairs fear recognition, at least in part, by impairing the processing of a feature in faces that is normally important to signal fear: the eyes.

refined emotions Emotions with refinement, or 'refined emotions' for short, form a contrast to what William James (1842–1910) referred to as 'coarse emotions'. They do not constitute a subset of emotions but, rather, pertain to a potential for every emotion to be refined. Refined emotions can be described as emotions that show little or no expressions or other behavioural manifestations, are focused on *feelings, and contain expansion of appraisal of the emotional object or event. Emotion refinement appears to rest on three conditions: detachment, higher-level second-order awareness, and self-reflexivity. This will be examined in terms of three interrelated components of emotion: *action readiness, appraisal, and pleasure processes.

Refined action readiness

Refined emotions are more felt than acted upon. They are marked by absence of conspicuous expression behaviour, by definition, and by absence of pronounced physiological arousal, but still involve strong feeling. Self-report indicates that they contain virtual or incipient states of action readiness, manifest in feeling and thought only. Merely felt action readiness appears possible thanks to the mental set of detachment. Detachment results from a mental set for, on the one hand, not engaging in actual interaction with the object or event and, on the other hand, adopting a state of receptive observation and unfocused attention that lets information come in from outside and lets associated meanings come up from within. Detachment entails a shift from operating in pragmatic action space to operating in the virtual space of mental imagery and simulation. Reflexive second-order awareness facilitates imagining action readiness of greater complexity than readiness for actual actions would allow.

Refined appraisal

In comparison to standard or coarse emotions, emotion refinement involves a shift from implicit to explicit appraisal, and from simple and immediate to complex and extended appraisal (see APPRAISAL THEORIES). For instance, when the beloved is perceived not merely as endearing, but also as vulnerable, one may savour the event with its subtle aspects, in which endearment and appraised vulnerability are felt by tracing or sketching one's action tendencies of caring for and handling with care. Second-order elaboration of appraisal may invest the appraised events with meanings far beyond their immediately given aspects.

Refined appraisals open up, and are fostered by, extra dimensions in mental space and time. In addition to capitalizing on the mental distance of detachment, second-order appraisals make explicit appropriation of temporality. Savouring involves lingering that slows down or halts pragmatic progress, and, in the Chinese tradition, entails processing that focuses on the incipient as well as the poststimulus phases of the event.

Refined pleasure processes

Refined emotions include refined pleasure or pain. Refined pleasure and pain may be understood as involving a competence of feeling more fully: feelings of *pleasure and *pain or the felt hedonic glosses of objects and events are brought centre stage. They may also lead to being aware of pleasure and pain at a more abstract level: awareness of what aesthetics refers to as 'harmony'. Harmony represents a holistic integration of multiple hedonic components, along with second-order awareness of that integration. Harmony results from successful integration that has proceeded well without effort.

This entails the further competence of reflexive second-order awareness. It allows the derivation of pleasure from one's awareness of pleasure. With sufficient acuity, it allows awareness of subtle distinctions in the phenomena, and of subtle shifts in balance between calls for letting go and restraint. It allows simultaneous experience of pain and pleasure as, for instance, in the Chinese Buddhist notion of emptiness (Sundararajan 2008): experiencing emptiness is an achievement that, as achievement, entails a certain pleasure.

Emotion refinement and the conduct of life

Emotion refinement does not merely appear in savouring and other forms of contemplation or dealing with pleasure. It can be a mode of handling painful emotions such as grief and suffering humiliation. It can form a mode of confronting everyday emotional situations, deepening their meaning and the scope of their sensed impact. It can be one of the ways in which conflicting emotional impacts are dealt with, such as combining self-esteem and regard for others. Refining one's emotions is capable of entering one's style of life, and become an aspect of a cultural conception of dignity.

Emotional refinement is a universal phenomenon. Yet it shows important cultural and individual variations in prominence, in the forms it takes, and in being or not being valued.

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Frijda, N.H. and Sundararajan, L. (2007). Emotion refinement: a theory inspired by Chinese poetics. *Perspectives on Psychological Science*, **2**, 227–41.

reflexes (emotional) Emotional reflexes are physiological or behavioural reactions evoked automatically in humans by affectively evocative stimuli. They resemble reflexes prompted in mammals by appetitive/rewarding or threatening/punishing events or by associated conditioned cues. In this reflex view, emotions are founded on brain circuits old in phylogenetic history that mediate survival actions. These reflex actions evolved because they helped preserve or protect the lives of organisms, ensuring propagation of their genetic inheritance. Schneirla (1959), for example, suggested that *approach* to moderate stimulation (and thus, possible nutrients), and *withdrawal* from high-intensity stimulation (potentially dangerous input), are basic reflexes 'applicable to *all* motivated behavior in *all* organisms' (see APPROACH/WITHDRAWAL). Konorski (1967), a student of Pavlov, proposed a functional typology that considered a wider range of unconditioned reflexes and related them to human affect. In this view, reflexes are either preservative (e.g. ingestion, copulation, nurture of progeny) or protective (e.g. escape, rejection of noxious agents): Preservative emotions underlie such affects as sexual passion, joy, and nurturance; fear and anger were considered protective affects. Dickinson and Dearing (1979) developed Konorski's dichotomy into a theory of two opponent motivational systems, aversive and attractive, each activated by a different, but equally wide, range of unconditioned stimuli. Masterson and Crawford (1982) further elaborated the concept of aversion reactions, noting that threat stimuli occasioned a variety of context-based reflexive behaviours—such as fleeing, freezing, fighting, and defensive burying—that were organized in the brain by a general 'defense motivation system'. He proposed, furthermore, that unpleasant emotions in humans could be construed as a phylogenetic mammalian development that involved the same underlying defence system circuitry.

In this motivational reflex view, the *hedonic valence* of a stimulus is determined by the dominant motive system: stimuli that activate the appetitive system are pleasant (preservative/attractive) and mediate positive affects; stimuli that activate the defence system (protective/aversive) are unpleasant and mediate negative affects (see VALENCE). Human emotions often occur, of course, in the absence of overt action—reflecting an evolved greater ability to delay or inhibit behaviour and to plan ahead. Although the insult of a boss may inflame, the wise employee does not throw the punch. Nevertheless, the physiology is reflexively mobilized for action, and in the hiatus of a withheld response, emotions are strongly experienced (see ACTION READINESS).

Measuring emotional reflexes

In response to threatening or attracting stimuli, a variety of somatic and autonomic reflexes, similar to those in other mammals, can be measured bioelectrically in human beings. For example, when prey animals first observe a predator at a distance, the animal stops moving ('freezes'), and orients to the predator. In this context, the prey animal's cardiac rate decelerates profoundly. A similar 'fear bradycardia' is found in humans looking at unpleasant pictures (e.g. mutilated bodies, threat to the viewer). Such unpleasant pictures also prompt reflexive contraction of the *corrugator ('frown') muscle of the face, and a phasic increase in skin conductance at palmar and plantar sites. The changes in heart rate and facial muscles during picture viewing covary significantly with reports of unpleasant feelings, and skin conductance increases reliably with higher self-ratings of emotional arousal (Bradley and Lang 2007b) (see PERIPHERAL PSYCHOPHYSIOLOGY).

Reflex-eliciting stimuli have are also been used to probe emotional states, and to explore the neural circuits that mediate emotion. In animal studies, fear conditioning—a neutral cue (e.g. a light) repeatedly followed by a painful shock—is used to establish an emotional state. At extinction, when the neutral cue is presented alone, an abrupt, startling stimulus is introduced that was not previously part of the procedure. The magnitude of the evoked *startle reflex is significantly greater in this context than when measured in the absence of the conditioned cue or during the same cue without the prior conditioning. Comparable startle potentiation findings have been obtained in fear conditioning studies with humans. Furthermore, in studies probing natural emotional cues (e.g. pictures, sounds) in human participants, systematic modulation of the startle reflex has been shown, i.e. increasing potentiation for more arousing unpleasant stimuli and relative inhibition for pleasant stimuli. These effects have been interpreted as an effect of motivational priming, i.e. the foreground stimulus generates a defensive state in the participant, which primes (enhances) activation of defensive reflexes such as startle.

Considering that emotional language (as reports of feelings) can be culturally shaped and that individuals learn to use emotional language instrumentally for reasons unrelated to their affective experience, the measurement of emotional reflexes has become an increasingly important tool in the study of emotion. These measures have the advantage of a clear neural provenance, providing a link between studies of human affect and its neuroscience base. Thus, research has established that fear potentiation of the startle response is directly attributable to activation of the *amygdala, a central structure in the older limbic brain, that projects signals directly to the pontine centre of the normal startle circuit. The amygdala also projects to the facial nucleus and the lateral hypothalamus, mediating facial

muscle and cardiovascular and other autonomic reflexes in emotion.

In summary, the activation of emotional reflexes is a fundamental feature of affect. The function of these reflex actions is to heighten sensory intake, as in the extra widening of the pupil to threat or attractive stimuli, and through a range of autonomic and somatic changes to direct and mobilize the body for survival actions.

PETER J. LANG AND MARGARET M. BRADLEY

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regret Regret is the negative emotion that we experience when realizing or imagining that our present situation would have been better had we decided or acted differently (see COUNTERFACTUAL EMOTIONS). It is a comparison-based emotion that reflects on our own causal role in the current, suboptimal situation (Van Dijk and Zeelenberg 2005). The emotion of regret is accompanied by feelings that one should have known better, by having a sinking feeling, by thoughts about the mistakes one has made and the opportunities lost, by tendencies to kick oneself and to correct one's mistake, by desires to undo the event and get a second chance, and by actually doing this if given the opportunity.

Regret is the prototypical decision-related emotion (see DECISION-MAKING). One only experiences regret when at some point in time one could have prevented the regretted outcome from happening. Of course, other emotions can also be the result of decisions; for example one may be disappointed with a decision outcome, or happy about the process by which one made a choice (see DISAPPOINTMENT; HAPPINESS). But all other emotions can also be experienced in situations where no decisions are made. For example, one can be disappointed with a birthday present, but one cannot regret it (unless, of course, the disappointing present was suggested by oneself).

Experiences of regret can be the result of a decision to act or a decision not to act. Early regret research indicated that people tend to regret their actions (commissions) more than their inactions (omissions). Later research showed that time is crucial (Gilovich and Medvec 2005). In the short run people tend to feel more regret over their actions (the stupid things they did or bought), but in the long run they tend to feel more regret over their inactions (the school they never finished, the career or romance never pursued). This temporal pattern to regret is due to a number of factors that decrease the regret for action over time (e.g. we take more reparative action and engage in more psychological repair work for action regrets than for inaction regrets), and to factors that increase the regret for inaction over time (e.g. over time we may forget why we did not act on opportunities, making the inaction inexplicable). An additional factor producing this temporal pattern is that we forget regrettable actions more easily than regrettable failures to act, resulting in a greater cognitive availability for our failures to act.

Regret is not only a passive emotional reaction to bad decisions but also a major influence in our day-to-day decision-making. This influence can take two forms. First, the experience of retrospective regret may produce a behavioural inclination to reverse one's decision or undo the consequences. For example, after buying a product which proves to be suboptimal, regret can motivate us to ask for our money back, or it may result in apologies in the case of interpersonal regrets. Second, decision-makers may anticipate possible future regret when making decisions, and choose in such a way that this future regret will be minimal.

This latter idea has some history in research on decision-making, starting with economists studying rational choice (Loomes and Sugden 1982). We now know that the influence of anticipated future regret on current decision-making can take several forms. First, people may avoid deciding in order to avoid making the wrong decision. People may also avoid or delay their decisions because they want to gather more information in order to make a better decision. Research has shown that anticipated regret influences many real-life decisions, such as salary negotiations, stock market investments, the prescription of medical testing, condom use, lottery play, and others (for a review see Zeelenberg and Pieters, 2007).

Regret is a functional emotion that can protect us from wasting money and help us to maintain good social relationships. Additionally, it makes bad decisions and wrong choices stand out in our memory and helps us to make better decisions in the future. This is also shown by the finding that we tend to feel most regret about things that we can still improve in the future, sometimes referred to as the opportunity principle (Roese and Summerville 2005).

Taken together, regret is an aversive emotional state that is related to counterfactual thoughts about how the present situation would have been better had one chosen or acted differently and people are motivated to avoid or minimize this emotion.

MARCEL ZEELENBERG

Landman, J. (1993). *Regret: the persistence of the possible*. New York: Oxford University Press.

Zeelenberg, M. and Pieters, R. (2007). A theory of regret regulation 1.0. *Journal of Consumer Psychology*, **17**, 3–18.

regulation of emotion Oscar Wilde (1854–1900) once noted that a 'man who is master of himself can end a sorrow as easily as he can invent a pleasure' (Wilde 1890/1988, p. 85). This quote nicely captures the idea that although emotions seem to come and go as they please, they can in fact be regulated. Present-day emotion regulation research builds upon prior work on psychological defences, *stress and *coping, and self-regulation (Ochsner and Gross 2005). To set the stage for our analysis of emotion regulation, we first outline a 'modal model' of emotion. We then distinguish emotion regulation from related processes, and present a process model that organizes the many different types of emotion regulation strategies.

The 'modal model' of emotion

Emotions involve a person–situation interaction that engages attention, has meaning to an individual, and causes a coordinated yet malleable multisystem response to the interaction. We believe that this conception of emotion—which we refer to as the 'modal model' of emotion—satisfies lay intuitions about emotion, and represents some of the major points of convergence among those concerned with defining and studying emotion (see EMOTION DENITIONS (PSYCHOLOGICAL PERSPECTIVES)).

In Fig. 1 we present the modal model of emotion. This model outlines how an emotion arises over time. The first element is a psychologically relevant situation, which is commonly external. However, relevant 'situations' can also be internal, taking the form of mental representations. These external or internal situations must be attended to in some way, which allows the individual to assess (or appraise) the situation's familiarity, *valence, and value relevance (Ellsworth and Scherer 2003). The emotional responses that follow from these appraisals are reflected in loosely coupled changes in experiential, behavioural, and physiological response systems (see SYNCHRONIZATION) (Mauss *et al.* 2005). Like other responses, emotions often change the situations that prompted them. This change is represented by the recursive arrow from one emotional response to the next eliciting situation in Fig. 1.

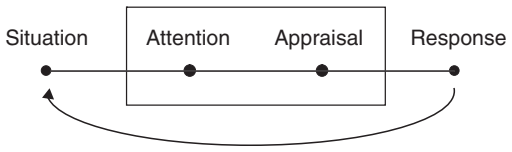

Fig. 1. The 'modal model' of emotion. From Gross and Thompson (2007).

Defining emotion regulation

Emotion regulation refers to influencing which emotions one has, when one has them, and how one experiences and expresses these emotions. This includes attempts to change the magnitude and/or duration of behavioural, experiential, and/or physiological aspects of the emotional response. Emotion-regulatory processes may be automatic or controlled, conscious or unconscious, and may dampen, intensify, or maintain positive or negative emotion, depending on an individual's goals. Emotions may be regulated by oneself (intrinsic regulation) or by others (extrinsic regulation). Although extrinsic regulation of emotions (e.g. by a parent) is crucial for the development of emotion regulation (Thompson 1991), our focus here is on the intrinsic regulation of emotions.

Emotion regulation is closely related to several other psychological constructs. Just as emotion is one of many types of valenced reaction classified as *affect, we see emotion regulation as one of several types of *affect regulation*. In addition to emotion regulation, affect regulation encompasses coping, mood regulation, and psychological defences. Emotion regulation is distinct from these processes in that it targets emotion rather than other forms of affect (for a fuller analysis see Gross and Thompson, 2007).

Given the goal of modulating one's own emotions, there are many different strategies one can employ. Regulation strategies have been categorized by the target of regulation (situation-focused or problem-focused coping: Lazarus and Folkman 1984), the way in which regulation is implemented (behavioural or cognitive interventions), or whether they involve engagement with or distraction from emotion (Parkinson and Totterdell 1999). Our approach has been to organize regulation strategies according to when in the emotion-generative process the strategy has its primary impact.

The process model of emotion regulation

The modal model of emotion (Fig. 1) provides a framework for representing the major points in the emotion-generative process at which individuals may intervene to shape the trajectory of an emotional response. In Fig. 2, the modal model is redrawn, highlighting five points at which regulation can occur. These five points represent five loose-knit families of emotion regulation strategies: situation selection, situation modification, attentional deployment, cognitive change, and response modulation. Everyday actions often involve multiple regulatory processes. Nonetheless, we believe that this process model provides a conceptual framework that is useful for understanding the causes, consequences, and mechanisms underlying various forms of emotion regulation.

regulation of emotion

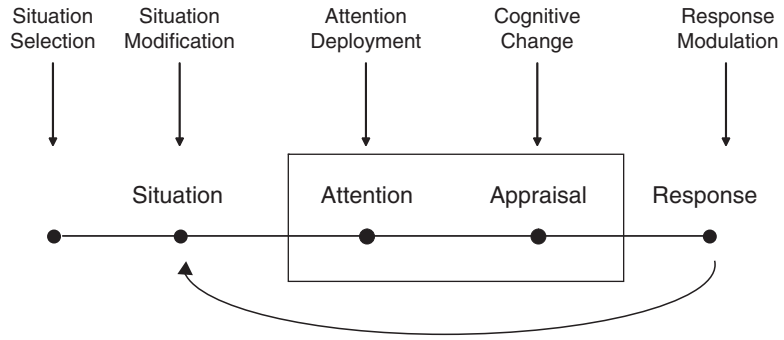

Fig. 2. A process model of emotion regulation that highlights five families of emotion regulation strategies. From Gross and Thompson (2007).

Situation selection is the most forward-looking emotion regulation strategy. This type of emotion regulation involves forming expectations about the emotional consequences of future situations and choosing between situations according to one's own emotional goals. Situation selection requires an understanding of remote situations, and of the expected emotional responses to these situations. It also involves balancing the short-term emotional effects of situations with their forecasted longer-term effects.

Consider a young professional who is faced with a considerable daily commute to work. Although factors that do not involve emotion may influence his choice of transportation, this particular young man gets so frustrated with traffic congestion that he's noticed that it interferes with his productivity. Therefore, he may opt to take a commuter train to decrease his anticipated agitation in the short term. In addition, this choice may coincide with longer-term emotional goals, such as the joy that arises when one sacrifices personal convenience for a societal cause, such as decreasing pollution.

Situation modification refers to the fact that, after selecting a situation, individuals can continue to tailor aspects of their environment to meet their emotional goals. Situation modification may require that individuals view situations as malleable, and see themselves as effective agents of change in those situations. As previously noted, situations can be external or internal, but situation modification—as defined here—has to do with acting upon the external, physical environment.

Our young professional from the previous example may modify aspects of his morning train ride that have the potential to cause him anger or fear. For example, he may change seats when he notices a heated disagreement arising between two passengers in his usual carriage or section. He may even attempt to break up or mediate the disagreement to avoid causing widespread fear or discomfort for other passengers, thereby engaging in intrinsic and extrinsic emotion regulation at the same time.

In addition to situation selection and modification, it is possible to regulate emotions without affecting the external environment. *Attentional deployment* occurs when individuals direct their attention in order to influence their emotions. In some cases, attentional deployment may be conceived of as situation modification performed upon an internal situation. Three major attentional manipulations are distraction, concentration, and rumination. Distraction focuses attention on unemotional aspects of the situation, or on another situation entirely. By contrast, concentration directs attention towards the emotional features of a situation. Rumination refers to the perseverative redirection of attention towards one's feelings and their consequences. Rumination on sad events has been shown to lengthen and worsen depressive symptoms (Nolen-Hoeksema 1993).

When our commuting professional reseats himself in another carriage, he might find himself next to a teenager engaged in a deeply personal conversation on her mobile phone. He may then choose to avoid his discomfort and embarrassment at overhearing her conversation by physically blocking the sound of her voice with earphones, or by attempting to become engaged in whatever reading material he has at his disposal.

Even after a situation has been selected, modified, and attended to, an emotional response requires an evaluation of the situation's meaning and one's capacity to handle the situation. *Cognitive change* exploits the flexible nature of appraisal, changing how one evaluates the situation to alter its emotional significance, either by changing how one views the situation or one's capacity to handle it. One form of cognitive change that has

received particular attention is *reappraisal (Gross 2002). Several studies have shown that the use of reappraisal can successfully modulate self-reported negative affect, startle *eye blink response, and blood flow to the *amygdala (Gross 1998, Jackson *et al.* 2000, Ochsner and Gross 2005).

Our commuting protagonist has made it through most of his morning commute when the train unexpectedly slows and an announcement is made that the train will be delayed by 30 minutes. Instead of getting angry, the young professional can choose to remind himself that he was dreading his first morning meeting, and be thankful that the delay didn't occur on another day, when he has a more desirable morning appointment.

Response modulation is a last-ditch effort to change the way an emotional response is manifested. Response modulation refers to attempting to change physiological, experiential, or behavioural responding directly, once the emotion is under way. Food, drugs, and alcohol are often used to regulate the physiological and experiential aspects of the emotional response. Another typical and relatively well-studied type of response modulation is the regulation of emotion-expressive behaviour. Studies have shown that generating emotion-expressive behaviour can increase the experience of that emotion (Izard 1990b). Decreasing emotion-expressive behaviour has mixed effects on emotion experience (decreasing positive but not negative experience) and actually increases activation of the *cardiovascular system (Gross 1998).

Just as our professional thinks his morning adventure is over, he runs into a close colleague on the train platform. This is the first time that he's seen her since she has earned a promotion for which they were both considered. Although he may feel disappointed, hurt, or angry that he was not promoted, he can choose to override his urge to scowl, pout, or curse at his colleague and instead smile and offer polite congratulations.

Directions for future research

It bears emphasizing that any one emotion-regulatory processes may be helpful in some settings and harmful in others. Although there are some data on the positive and negative ramifications of employing different emotion-regulatory strategies (Parkinson and Totterdell 1999, Gross and John 2003), no strategy is likely to be more adaptive than others across all possible contexts. Consistent with a functionalist perspective, regulatory strategies may accomplish a person's own goals but be perceived by others as maladaptive. Imagine the outcome if the commuter in the example above attempted to use situation selection and avoided going to work whatsoever in order to sidestep friction with his recently promoted colleague. Successful regulation most likely involves the flexible application of a range of context-appropriate emotion-regulatory processes. Future research is needed to investigate not only an individual's skill at implementing individual strategies, but at selecting the appropriate place and time to use each strategy.

One point of debate is over the extent to which emotion regulation can be separated from emotional responding (Campos *et al.* 2004, Gross and Thompson 2007). Most research on emotion regulation has reported the effects of regulation on measures of the emotional response (experience, behaviour, expression, physiology). A recent approach to the separation of response and regulation has been to adopt a dual-process cognitive neuroscience approach which makes contact with the cognitive control literature (Ochsner and Gross 2005). This approach has most commonly taken the form of functional magnetic resonance imaging studies investigating the neural basis of reappraisal. These studies have identified a network of prefrontal regions that are more active when participants are actively reappraising than when they are passively viewing negative stimuli. Activity in some of these prefrontal regions has been shown to predict reappraisal-related changes in self-reported negative affect (Ochsner *et al.* 2002) and activity in emotion-generative regions such as the amygdala (Urry *et al.* 2006). Future studies will clarify the relationship between emotion-generative and emotion-regulatory processes.

KATERI MCRAE AND JAMES J. GROSS

Gross, J.J. (ed.) (2007). *Handbook of emotion regulation*. New York: Guilford Press.

relevance detection Cognitive theories of emotion posit that emotions result from an evaluation of cognized objects (typically events or states of affairs) as good or bad (see APPRAISAL THEORIES). But what does it mean to evaluate an event as good versus bad? Most proponents of cognitive emotion theory in psychology (e.g. Arnold, Frijda, Lazarus, Ortony and colleagues, Roseman and colleagues, and Scherer; see Scherer *et al.* 2001a) answer this question as follows: to evaluate an event as good versus bad means to appraise the event as congruent versus incongruent with what one *desires, wants, wishes, has as one's *goal, or is motivated to obtain (as a general term for these various motivational states, Frijda (1986) proposed '*concern') (see MOTIVATION). However, this assumption implies that emotions are not only caused by cognitive states (perceptions, *beliefs, judgements), but also, at least indirectly, by motivational states: emotions occur if an event (1) is believed to be certain or at least possible and (2) is evaluated as congruent or incongruent with one's concerns.

Lazarus combined these two appraisals into a single process termed **primary appraisal*. The emotionally significant information provided by primary appraisal is that *a good or bad event—and hence, the satisfaction or frustration of a concern—is certain or possible*. Appraising an event in any of these ways means to appraise it as concern-relevant; otherwise it is concern-irrelevant. Primary appraisal is thus the process that detects concern-relevant changes in the world as well as, simultaneously, in the 'fate' of the concerns affected by the world changes. In both of these senses, primary appraisal is the process of relevance detection. Accordingly, emotions can be characterized as responses to the detection of concern-relevant changes (Frijda 1986).

Being caused by the detection of concern-relevant events, emotions (emotional experiences) *carry information* about the occurrence of these events and the fate of the concerns affected by them. This information is undoubtedly of high importance to the individual. One may therefore speculate that the signalling of concern relevance is the evolutionary function (or at least an important function) of emotions. This has indeed been proposed by several theorists (e.g. Frijda, Oatley, and Johnson-Laird). However, one may ask, why is the information about concern-relevant changes 'broadcast' in the form of emotional experiences (e.g. feelings of pleasure or displeasure)? A partial answer is probably that consciousness is needed to make this information available system-wide, presumably because this is a precondition for it to exercise global control (i.e. to influence cognition and action).

So far, relevance detection has been discussed assuming a system of mental representations suited to support beliefs and desires (i.e. propositional attitudes). Such a representation system probably exists, at least in elaborated form, only in humans and higher mammals. On the other hand, the behaviour of even the simplest systems appears to be controlled by feedback mechanisms that can be described, metaphorically, as involving the comparison of 'believed (or perceived)' states of the world with 'desired states'. This being the case, it is reasonable to ask whether any of these 'lower level' analogues of the concern-relevance detection mechanism can give rise to emotion analogues in humans, as well as in other creatures (including artificial agents; Allen 2001). Both questions have been answered affirmatively by some theorists. Concerning humans, for example, Frijda (1986) proposed that an extended concept of desire—the concept of a sensory set-point—is both necessary and sufficient to bring sensory pleasures and displeasures (the hedonic tone of sensations of colour, sound, taste, etc.) within the reach of appraisal theory (see also Arnold 1960). Scherer and Leventhal (see Scherer 2001a,c) have gone further to propose that emotion-producing relevance detectors exist on each of three representational–computational levels in humans: the conceptual (propositional) level, the schematic level, and the sensorimotor level (see LEVELS OF PROCESSING). A problem of multilevel models is to specify how the different levels are related, that is, if (and if yes how) they communicate with each other (Allen 2001). Independent of this issue, it is conceivable that analogues of the human concern-relevance detection mechanism are responsible for analogues of human emotional reactions in animals, even those low on the evolutionary scale (see ANIMAL EMOTIONS). If so, the concern-relevance detection mechanism responsible for human emotions may only be the manifestation of an old evolutionary principle in a highly developed representational system.

For a discussion of some of the issues involved in constructing *computational models* of concern-relevance detection, and of appraisal processes more generally, readers are referred to Allen (2001) and Reisenzein (2001).

RAINER REISENZEIN

relief Relief is a positive emotion that is felt when a negative outcome did not materialize (see POSITIVE EMOTIONS; OUTCOME EXPECTANCIES; COUNTERFACTUAL EMOTIONS). It is a prospect-based emotion (Ortony *et al.* 1988), and closely linked to *disappointment (felt when a positive outcome did not materialize) and satisfaction (felt when a positive outcome did materialize). Relief may be felt in comparison to a prior expectation, but also in comparison to a counterfactual outcome that was never anticipated (If only I had taken that plane, I would have been dead as well). This makes relief a cognitively complex, comparison-based emotion that is relevant in *decision-making situations. As such, the experience of relief will often produce negative emotions as a by-product. Realizing that one missed out on something very negative also causes one to be aware of the possibility of these negative outcomes, eliciting sadness, anger, and fear (Oliver 1996).

Relief can be considered an end state in the sense that it does not have clear motivational properties associated with its experience. However, in the consumer behaviour literature, relief has been described as something that consumers may strive for in products or services that eliminate something aversive (medication, prophylactics, insurances, legal defence, etc.)

MARCEL ZEELENBERG

religion and emotion (historical perspectives) Religious experience is emotional by definition. William James (1902) introduced it as an instinctive impulsion, comparable with love, anger, ambition, and jealousy. Religion gives to life an enchanted and inexplicable

perspective. James observed that one has it, or not. It is a gift to be considered as an organic endowment according to physiologists, or something due to divine grace according to theologians. Some individuals can be deprived of religion. But no society exists without such unexplained *values, *beliefs, and ritual behaviours. The affirmation or the denial of these symbolic foundations produces strong emotional reactions, as everybody knows. Harvey Whitehouse (2004) has shown how the use of emotion in initiation rituals (especially through rites of terror) may have, in certain cultures, a cognitive function. Emotion appears as a mnemonic device, intended to set firmly in the mind of initiates some religious teaching of important social value.

Maybe the best expression of the emotional characteristic of religion is found in the concept of sacredness. The classic study on sacredness is Rudolph Otto's (1917) *The idea of the holy*. Written by a Lutherian theologian specializing in comparative mysticism, this book tries to define the basic religious experience as an encounter with God, before any theological construction of this experience. Otto's approach lies on the assumption of a universal experience of the holy (the *numinosum*) as being the evidence of a contact, or even a seizure. The creature would be suddenly confronted by the Creator. This approach may be described as a phenomenology of theophany (or epiphany). It is focused on the description of a variety of emotions considered as human reactions to the mysterious presence of a transcendent reality. According to Otto the basic category of such affective, emotional, and religious reactions, before any knowledge of God, is what he calls the experience of the numinous. This numinous (*numinosum* in Latin, from *numen*) is conceived by him as an impersonal power, perceived through a feeling of terror, of fear. He calls this feeling *mysterium tremendum*. It is manifested by tremor, trembling, and quivering. The *tremendum* implies and induces humility in front of the *mysterium*. The awareness of the radical alterity (otherness) of this *mysterium* induces the feeling of its *majestas*. From *fear, one is conducted towards admiration (see ADMIRATION/AWE). The *mysterium tremendum* becomes *mysterium fascinans*. Fear and admiration, terror and veneration coincide.

Considered on a very large scale, this experience of *awe*, or (in German) *Ehrfurcht*, may look universal. But this type of phenomenon should be contextualized, and analysed more precisely. In religious life, as far as scientific observation is concerned, the worshipper pretends very rarely to be confronted by the divinity without mediation. Such encounters would normally be considered as real transgressions, to be avoided.

Considered by Otto as being the stimulus of every religious emotion, this meeting face to face with the Unknown is an ethnocentric and Judeo-Christianizing occasional concept, not a universal one. As a common experience, the holy or the sacred are better understood in terms of hesitation, scruple, restraint, and caution, in front of an object which does not necessarily have to be a god. This object could be a person (human or nonhuman), something inanimate, a natural landscape, a building such a temple, a special space or a special time, and so forth. The main characteristic of this object is its supposed remoteness. It has to be conceived of as being separated from common, banal, experience.

The emotion tied to sacredness actualizes the essential values of a person, those which relate her to a precise culture and give her a social identity. But even if the experience of the sacred is emotional by nature, most religions are most of the time disdainful of emotion. They feel uneasy in front of any potential disturbance. They strive to attain ideal calm, order, and serenity. The ritualization of emotions, in many religious ceremonies, has as its function not to teach something, but to purify emotions: in the Eleusinian mysteries, for example, the initiate had to go through nocturnal experiences of fear and agitation. A dramatized exaltation guided him from this trouble towards a comforting luminous revelation. Ritualization induces a cathartic effect, by mastering and controlling emotions. Nothing more than a ritual is harmoniously assembled and susceptible to be reproduced. Even when it is concerned by violence and emotion, as for example in some Christian stagings of the Passion at Easter.

Emotion may be part of the religious ritual, or result from it. But it may also appear as soon as normal ritual performance is jeopardized. It is therefore important not to oppose pretended emotional religions and pretended less emotional religions. The institutional dimension of religion assures the control of emotions. This process of ritualization may be compared with the techniques of dramatization of trance as they were described by ethnologists (Leiris 1958). Emotion, in the context of religion, has to be perceived first of all in relationship with the regular, scrupulous, and harmonious performance of the rite. This implies that the mastering of affects is a preliminary condition to a peaceful relationship with the gods.

PHILIPPE BORGEAUD

Borgeaud, Ph. (2007). Rites et émotions. Considérations sur les mystères. In: J. Scheid (ed.), *Rites et croyances dans les religions du monde Romain* (Entretiens sur l'antiquité classique, tome LIII), pp. 189–229. Genève-Vandoeuvres: Fondation Hardt.

religion and emotion (psychological perspectives) At the outset, a distinction needs to be made between religion and spirituality. When Nietzsche (1889/2003) called for 'spiritualizing the passions' he

was not advocating religion, for he had already declared that 'God is dead'. Even if we limit consideration to religion, emotionally relevant distinctions can be made, for example, between authoritarian versus humanistic religions (Fromm 1950), intrinsic versus extrinsic religious orientations (Allport 1950), and religion as an open-ended quest for meaning versus a single-minded commitment, whether intrinsically or extrinsically oriented (Batson *et al*. 1993). In this brief entry such distinctions can only be noted, not discussed. Rather, the focus is on five ways in which religion, as an institutionalized set of *beliefs and practices, not only influences the emotional lives of individuals but can also serve as a resource for the study of emotion.

Religious practices are elicitors of emotion

Religious rites are common triggers for profound emotional experiences, from mystical bliss and awe to the throes of anxiety and despair. Closer to everyday experience are the sense of belonging, hope, and joy that spread through a congregation as they worship together (see CONTAGION). Of course, not all religiously inspired emotions are benign: self-mortification and self-righteous aggression against others have been commonplace, today as well as historically.

Religion helps regulate emotions that are elicited in nonreligious contexts

Good examples are the seven deadly sins of traditional Christianity: anger, pride, lust, greed, sloth, gluttony, and envy. By definition, 'sinful' emotions are regulated down; other emotions, those considered virtuous (e.g. love, compassion, humility), may be regulated up. Significantly, religiously inspired regulation applies not only to behaviour but also to thoughts and feelings. This, in turn, implies higher-order or multiple levels of consciousness, as when a person feels guilty about being proud of becoming angry at, say, an offensive but disadvantaged colleague (see REGULATION OF EMOTION).

Religion is an agency for the socialization of emotion

Einstein observed that 'a man's worth is not measured by what his religious beliefs are but rather by what emotional impulses he has received from Nature during his lifetime' (letter to Sister Margrit Goehner, February 1955, Einstein archive). The sentiment expressed by Einstein may be unassailable; nevertheless, to speak of emotional impulses as he does is misleading, for it implies greater unity to emotions than actually exist. Emotions are complex syndromes, the components of which can be acquired independently, only later to be integrated into a whole, if at all. For an instructive analysis of this process as it involves the socialization of trance among the Balinese, see Bateson (1976).

Religion provides the blueprints (beliefs and rules) for the creation of emotions unique to a creed

Einstein's observation, quoted above, is misleading in another respect, namely, it implies too strict a division between religious beliefs and related emotional states. Some emotions can be divorced from the beliefs and rules involved in their creation, but others cannot. The Balinese variety of trance, for example, could not exist outside its religious context. Other examples of emotions specific to a creed are easily found, such as stigmata (suffering accompanied by bodily marks or sensations in imitation of Christ's crucifixion), and the Chinese Buddhist emotion of *kong*, a sense of emptiness that is yet full of meaning (Sundararajan 2008).

The above four ways in which religion influences emotion (elicitation, regulation, socialization, and blueprints for construction) are not independent, nor do they differ in principle from related nonreligious influences. The crucial point is that religion offers an important but underutilized resource for natural experiments. The fifth way that religion can help us understand emotion is more conjectural.

Religion is a rich source for thought experiments

One of the earliest works on anger was by the early theologian Lactantius (*c*.240–*c*.320). How can God—an unembodied, omniscient, and beneficent being—become angry, as portrayed in the Old and New Testaments of the Bible? In order to answer such a question, Lactantius had to analyse anger in its most abstract and fundamental form. Similar questions could be asked about other emotions, as they might be postulated to occur, or not occur, in an afterlife. A naturalistic counterpart to such hypothetical questions might be: how can a supercomputer be programmed not just to express emotion (by sending an error message, say, with swear words and invectives) but actually to be in an emotion-like state (Fellous and Arbib 2005)? Gods and computers differ, of course, in their architectural requirements, but conjectures about each force us to think creatively about the meaning and functions of emotions.

To summarize, the potential contribution of religion to emotion is not limited to phenomenological analyses of religious experiences, nor to possible ameliorating benefits of certain religious practices (e.g. prayer, meditation, yoga). As an institutionalized set of beliefs and practices, religion offers a rich resource for the study of the elicitation, regulation, socialization, and construction of emotional syndromes, and for the analysis of emotional concepts.

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Haidt, J. (2003). The moral emotions. In: R.J. Davidson, K.R. Scherer, and H.H. Goldsmith (eds), *Handbook of affective sciences*, pp. 852–70. New York: Oxford University Press.

Watts, F. (2007). Emotion regulation and religion. In: J.J. Gross (ed.), *Handbook of emotion regulation*, pp. 504–22. New York: Guilford Press.

repression Throughout his life Sigmund Freud (1856–1939), the founder of psychoanalysis, claimed that the purpose of psychoanalytic therapy was to lift the repression that excluded unacceptable mental contents from awareness and to 'make the unconscious conscious'. In 1893 he and Josef Breuer (1842–1925) argued that repression operated on memories of traumatic events and that allowing these memories back into consciousness could bring about a permanent cure for hysteria. By the beginning of the 20th century Freud preferred to believe that repression operated primarily on infantile drives and wishes rather than on memories of actual events.

Repression sometimes refers to a process whereby unwanted material is turned away before it reaches awareness at all (Freud's 'primary repression'). This material, Freud argued, re-enters awareness in disguised ways, such as slips of the tongue. Repression can also mean that a person becomes aware of unwanted mental contents and then deliberately attempts to exclude them from consciousness (Freud's 'repression proper' or 'after-expulsion'). Although there is little empirical evidence for 'primary repression', many memory researchers would have little problem with 'after-expulsion'. It is widely believed that everyday mental functioning depends on flexible excitatory and inhibitory mechanisms that select relevant material and exclude unwanted material from entering consciousness.

Do people first forget and later remember significant traumatic incidents? Numerous studies have found that many clients in therapy for the effects of childhood sexual abuse report having periods in their lives when they could not remember that the abuse had taken place. People have reported forgetting of nonsexual as well as sexual traumas, and many of the incidents have received some corroboration. These findings strongly suggest that it is possible to forget traumatic incidents but do not indicate whether repression is involved or rule out the likelihood that some 'recovered memories' are not accurate.

CHRIS R. BREWIN

Brewin, C.R. (2003). *Posttraumatic stress disorder: malady or myth?* New Haven, CT: Yale University Press (see chapter 7, Myths, memory wars, and witch-hunts, and chapter 8, The return of repression?).

resilience Resilience is variously defined as the absence of a psychopathological outcome or successful adaptation following exposure to stressful or potentially traumatic life events or life circumstances (see STRESS). Thus, it involves both the capacity to maintain a healthy outcome following exposure to adversity as well as the capacity to rebound after a negative experience (see VULNERABILITY). Early work in this area developed out of the recognition that some children exposed to extreme conditions of poverty or neglect nonetheless maintained psychological health and effective functioning and even thrived under these conditions. Recent work has noted that a substantial number of individuals who are exposed to traumatic events (physical assault, violence, sudden and tragic loss) do not succumb to the negative experience by developing mental disorders or exhibiting extreme distress and instead maintain a healthy emotional and psychological stance. Most scholars resist seeing resilience as a single personality trait or individual attribute. Instead, resilience is seen as a process that is facilitated by the presence of individual protective factors (e.g. high *self-esteem or social skills) as well as environmental ones (e.g. a supportive family or peer network). Emerging work seeks to identify psychobiological factors that may also play a role in the development or maintenance of resilience.

ROXANE COHEN SILVER

Bonanno, G.A. (2004). Loss, trauma, and human resilience – have we underestimated the human capacity to thrive after extremely aversive events? *American Psychologist*, **59**, 20–28.

Luthar, S.S., Cicchetti, D., and Becker, B. (2000). The construct of resilience: a critical evaluation and guidelines for future work. *Child Development*, **71**, 543–62.

respiration Respiration is a crucial and often-overlooked physiological process that is closely associated with emotionality. While much of the literature on respiration is devoted to either clinical problems, such as apnoea or asthma, or the physiological processing of gasses, other breathing phenomena can be potent indicators of emotional activity. Sighing, for instance, has a characteristic pattern of long inspiration followed by a shorter and often forceful expiration and is indicative of stress reduction even in rats (Soltysik and Jelen 2005). Respiration is also physiologically coupled to cardiac activity (see CARDIOVASCULAR SYSTEM; PERIPHERAL PSYCHOPHYSIOLOGY). Respiratory sinus arrhythmia (RSA) is a change in the pattern of heart rate as a function of breathing cycle and is closely associated with responses to stress and emotional reactivity. RSA is primarily mediated by vagal influences and respiration affects vagal activity through both central nervous system mechanisms and feedback networks related to carbon dioxide metabolism (Berntson *et al.* 1993). Recent technological advances have made noninvasive measurement of breathing much easier. As an example, Van Diest *et al.* (2006) used both inductive plethysmography and nasal air sampling to measure breathing changes in persons engaging in emotional imagery and found changes in both ventilatory behaviour and carbon dioxide utiliza-

tion. Interestingly, a major component of their findings indicated that anxiety reduced variability in breathing patterns.

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reward Reward is a desirable outcome that is obtainable in dependence on behaviour. That is, reward differs from other desirable or pleasant stimuli, like gifts, in terms of its contingency upon achievement and an organism's implicit or explicit knowledge about this contingency. In general, psychological researchers have attributed two functions to reward—the first is 'reinforcement' for learning new behaviours, the second is 'incentive' for motivating behaviour (Beck 2004) (see PUNISHMENT).

Reward is probably the most powerful variable that influences learning in terms of a relatively stable change of behaviour in dependence on experiences (see LEARNING, EMOTIONAL (NEUROSCIENCE PERSPECTIVES); ASSOCIATIVE PROCESSING). According to the 'law of effect' (Thorndike 1911)—the fundamental basis of instrumental or operant conditioning—behaviour is shaped in dependence on its contingent consequences. Consequences that are *satisfying* (rewarding) will augment and consequences that are *annoying* (punishing) will reduce the probability of repeating a certain behaviour in the future. Interestingly, Thorndike referred to the affective characteristics of reward—an aspect that was later neglected and even rejected in American behaviourism and that is still a topic of discussion in modern psychology.

Reward as reinforcement

The idea that reward functions as reinforcement was most strongly stressed and defended by C. L. Hull (1884–1952) and B. F. Skinner (1904–90). Both researchers were eminent and radical behaviourists and thus committed to the idea of discovering the mechanistic laws of behaviour without considering intervening cognitive or affective processes. Around 1940, both Hull and Skinner published highly influential ideas and discoveries about the effects of reward on behaviour. While Skinner's research on operant conditioning was primarily concerned with elaborations of the law of effect and the question of *how* reinforcement affects learning, Hull was more interested in explaining *why* learning occurs at all. For Hull (1943), in his drive-reduction theory, any behaviour is the product of an organism's actual energetic state and its learning history. Energetic state was described as 'drive' and quantified as the duration of deprivation of satisfaction of biological need. Learning history was described as 'habit', with the assumption that habit strength augments with increasing numbers of past reinforcements an organism has received for executing a certain behaviour. Although Hull avoided terms like satisfaction or pleasure, he proposed that the reason *why* reward can reinforce behaviour was that reward reduces drive. As a consequence, 'drive' motivates an organism to do something, and its reward history will determine which behaviour is carried out for drive reduction.

Skinner's perspective on how reward affects learning and behaviour was more reductionist (e.g. Skinner 1938). Accordingly, organisms continuously emit behaviours. If any behaviour is by chance followed by a reinforcing stimulus—Skinner avoided the term reward—the probability of repeating that behaviour increases. There are two types of reinforcement—positive and negative. A positive reinforcer operates on behaviour by means of its presence (e.g. receiving a food pellet as consequence of a bar press), while a negative reinforcer functions by its elimination (e.g. a reduction of noise as consequence of a bar press). The effects of reinforcement on the effectiveness of the acquisition and the extinction of behaviour are significantly influenced by reinforcement schedules—a topic to which Skinner devoted much of his research with his famous 'Skinner box' that has revealed very detailed knowledge about the effects of reward on behaviour (see Fig. 1).

As the basic rule, compared with intermittent reinforcement, continuous reinforcement results in faster acquisition but also faster extinction when reinforcement is no longer provided. Moreover, reinforcement schedules can be distinguished as a function of the contingency rule—reward for proportions of correct responses or for a correct response after a certain time interval. A discriminative stimulus that is learned according to stimulus learning—which is the same as Pavlovian or classical conditioning—can signal if such a

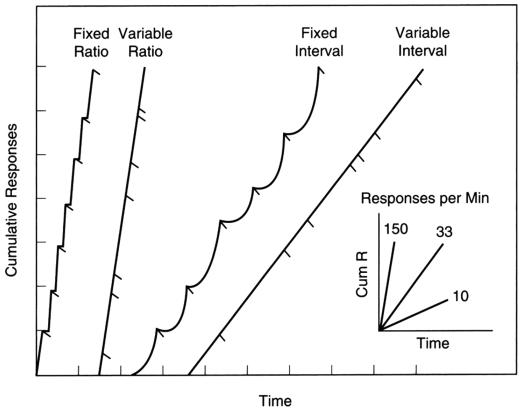

Fig. 1. Effects on cumulative responses as a function of different reinforcement (reward, respectively) schedules. From Beck (2004, p. 186).

contingency between behaviour and reward exists or not. To give an example, a pigeon in a Skinner box can learn that each fifth bar press is reinforced with a food pellet, but only in the presence of a green light and not in the presence of a red light. Skinner was sure that reward (reinforcement, respectively) is much more efficient in learning than *punishment, because punishment can only suppress behaviour but not eliminate an existing behaviour-reinforcer contingency.

Reward as incentive

The conceptualization of reward as incentive is closely connected with two important experimental observations—*latent learning* and *motivational shifts*. A famous study by Tolman and Honzik (1930) demonstrated that rats who could explore a labyrinth for 10 days without finding any reward in the labyrinth's goal chamber outperformed rats who had been continuously rewarded, when the previously nonrewarded group found a reward on the eleventh day of the experiment. That is, the formerly nonrewarded group had learned the way to the goal chamber—according to Tolman, the rats had formed a *cognitive map* of the labyrinth—but did not use their 'knowledge' until it was purposeful to do that. Together with other groundbreaking observations in Tolman's laboratory, this discovery led to an important distinction: learning is not the same as behaviour. Learning depends on experience, while behaviour depends on *motivation—especially in terms of the expectancy of finding a valuable reward or incentive to reduce drive by applying what has previously been learned. This distinction led to the development of social-cognitive theories of motivation and learning that further highlighted the role of expectancies for obtaining reward as a motivational variable (see Hergenhan and Olson 2005).

Another observation that challenged the view that reward is nothing but reinforcement was the observation of 'motivational shifts'. In a well-known study by Crespi (1942), one group of rats was always rewarded with 256 food pellets for running through a straight-alley maze. The important manipulation was that from the 21st trial on the reward was reduced from 256 to only sixteen food pellets. As the result, the rats reduced their running speed by about 50%. Another group of rats first received only one pellet as reward and than sixteen pellets, with the result that this group ran three times faster than before. In still another group, the rats always found sixteen pellets. This group did not show significant motivational shifts manifested in running speed. These performance effects are compatible with new evidence that the magnitude of reward directly determines effort intensity when task difficulty is unclear (e.g. Richter and Gendolla 2007) (see Fig. 2).

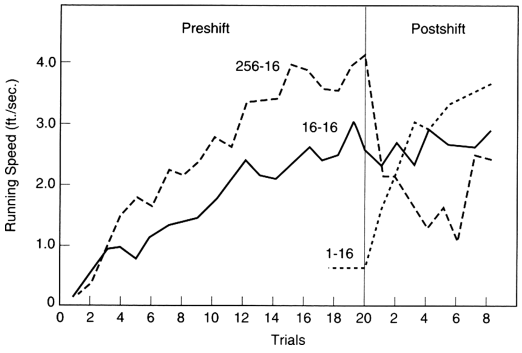

Fig. 2. Motivational shifts as a consequence of increasing (positive contrast) or decreasing (negative contrast) reward. From Beck (2004, p. 203).

Similar effects can be obtained by modifying the quality of reward—children work harder for getting ice cream than for getting a slice of dry bread. These observations challenged the view that reward influences behaviour because it merely reduces drive or need strength. Rather, the incentive value of reward significantly changes behaviour, and organisms actively seek reward rather than merely getting reinforcement.

Outside American behaviourism, these effects had already been considered, as for instance in the concept of *goal valence* in Kurt Lewin's (1890–1947) field theory, where the subjective value of a reward depends on the organism's need state *and* the attractiveness of a goal object (Lewin 1926). But also within animal psychology, it became more accepted that hedonic experiences play an important role in learning and motivation and that incentive is largely determined by anticipated or experienced *pleasure. This led to the formulation of more complex models of learning (see Berridge, 2001, for a discussion). However, despite this evidence that reward works as an incentive due to its affective aspects, it should not be forgotten that need states can significantly moderate the experience of pleasure, as evident in the phenomenon of 'alliesthesia' (Cabanac 1971): a piece of chocolate cake tastes better when one is hungry than when one is satiated.

Reward and affect

Within experimental psychology, the first considerations of affective experiences as reward may be found in Young's (1959) idea of conditioned, anticipatory affective arousal as incentive to execute behaviours and in Mowrer's (1956) two-factor theory of learning. According to the latter idea, which was developed to explain avoidance learning, the feeling of relief rewards the avoidance of stimuli or situations that elicit fear because

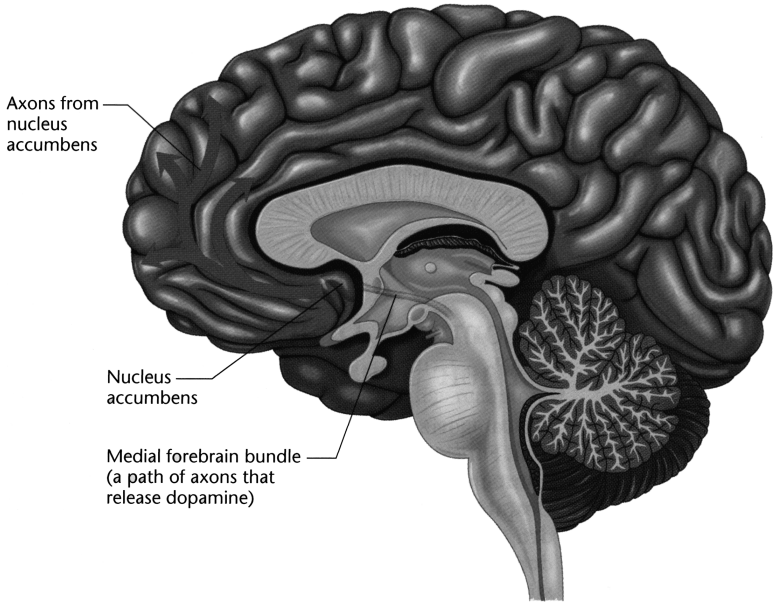

Fig. 3. The dopamine system and reward. From Kalat (2007, p. 72).

they have been associated with pain by classical conditioning; for example a box chamber where electric shocks are delivered, a shaky bridge, or a crowd of people. That is, phobic individuals manifest avoidance behaviour because avoidance is rewarded by the positive feeling of relief. An even more hedonic perspective can be found in Atkinson's (1964) achievement motivation theory, according to which the primary reward for achievement behaviour is strictly affective—experiencing pride following success (positive incentive) and avoiding shame following failure (negative incentive).

Other research has even shown that organisms prefer pleasure over drive reduction. In a famous study by Olds and Milner (1954), rats that had learned to electrically stimulate their hypothalamic brain area by means of a bar press developed addictive-like behaviour and stimulated their brains up to 2,000 times per hour. Those rats also preferred the electrical stimulation to direct drive reduction after longer periods of deprivation. These findings support the view that reward works as incentive because it provides pleasure—the most direct way to experience pleasure was the most preferred. This idea is also compatible with the finding that the behavioural effects of reward significantly depend on the neurotransmitter dopamine, which seems to be the substance leading organisms to learn (i.e. to repeat) behaviours. Dopamine secretion is associated with the experience of pleasure, and blocking dopamine reception in the brain significantly reduces the establishment of behavioural preferences—learning and approach motivation dramatically decrease (see Hoebel *et al*. 1999). A brain structure that is strongly involved in the regulation of dopamine outflow is the nucleus accumbens, which is close to the hypothalamus—the brain area where Olds and Milner placed their electrodes (see Fig. 3).

Still more observations are of note regarding the role of the hedonic aspects of reward. Frequently executed (i.e. preferred) behaviours can function as reward for other behaviours that are less attractive (Premack 1959)—a principle that is frequently applied in education—'first you tidy your room, then you can watch TV'. Moreover, individuals execute many behaviours for the sake of self-reward. For instance, people actively search levels of optimal stimulation, which is associated with *well-being. Examples are behaviours like exploration and sensation-seeking instead of resting in a state of equilibrium. In fact, boredom and understimulation have been found to be highly aversive (see Silvia 2006b). Moreover, individuals self-regulate their mood states by executing those behaviours that promise well-being, especially when they are in intense positive or negative moods (Gendolla 2000).

Boundary conditions of reward effects

In contrast to the evidence discussed so far that reward increases performance, there are also indications that reward can reduce performance—especially when it

corrupts interest or intrinsic motivation (see Deci 1975). However, this corruption effect of reward seems to depend on the important boundary condition that obtaining reward is not under the control of the performing individual. When reward is perceived to be contingent upon performance, and therefore regarded as a signal of competence, it has no detrimental effect on performance (Harackiewicz *et al*. 1984). If, by contrast, individuals feel controlled by a reward, reactance is likely to occur, leading to diminution of both interest and performance (Brehm 1966). Furthermore, a prominent example of reduced reward effects pertains to *depression. Evidence from self-report, behavioural, and physiological data suggests that rewards frequently lose their motivating effects under conditions of depression or related negative affect phenomena (see Gotlib and Hammen 2002).

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risk factors for emotional disorders Epidemiological data indicate that over half of all people will experience a significant emotional disorder at some point in their lives (see DISORDER (AFFECTIVE, EMOTIONAL)). Not surprisingly, therefore, across both industrial and developing countries, emotional disorders exact a heavy economic and societal toll. Depressive disorders, for example, are the fourth leading cause of global disease burden and the leading cause of disability worldwide (Hyman *et al*. 2006) (see DEPRESSION). The chronicity and recurrence of emotional disorders, combined with their significant prevalence and costs, makes it imperative that we identify factors involved in their onset. Research examining risk factors for the development of emotional disorders has the potential to elucidate their underlying mechanisms and to inform efforts to prevent their occurrence, in addition to providing important information about normal regulatory processes.

The term 'risk factor' is used to describe variables that statistically increase the probability of experiencing a disorder (see VULNERABILITY). Thus, risk factors for emotional disorders can include such demographic variables as gender, education, and income, as well as variables that are more closely related to theoretical formulations of the disorders and, consequently, more likely to inform us about why people develop such disorders. In this context, there is converging evidence that having a parent with an emotional disorder is one of the most important risk factors for emotional disorders in children (see GENETICS OF AFFECT). For example, the offspring of a parent who is diagnosed with unipolar depression has a three- to five-fold increased risk of developing a significant emotional disorder (Goodman and Gotlib 1999) (see UNIPOLAR DISORDER). It is not yet clear, however, *why* these children are at risk. While genetic factors certainly contribute to the risk, it is becoming increasingly clear that the adverse effects of parental psychopathology are transmitted through multiple mechanisms, including innate dysfunctional neuroregulatory mechanisms, exposure to, and modelling of, negative cognitions, behaviours, and affect, the stressful context of the children's lives, and an inability to deal effectively with stress and to regulate negative emotions (Goodman and Gotlib 1999) (see COPING; REGULATION OF EMOTION).

In particular, difficulties in regulating negative emotions in the face of *stress appear to represent a broad and important class of risk factors for emotional disorders. The construct of emotion regulation involves the utilization of behavioural and cognitive strategies in efforts to modulate intensity and duration of affect. For example, theorists have recently postulated that individuals who are vulnerable to developing depression are characterized by a compromised ability to control their affect in response to life stressors. From this perspective, therefore, in attempting to understand risk for emotional disorders it is critical to examine psychological and biological responses to stress as well as the course of recovery from these negative affective states. Recent work in this area has clearly highlighted the importance of examining and integrating diverse domains involved in emotion dysregulation, including cognitive functioning, hypothalamic–pituitary–adrenocortical (HPA) axis activity, and patterns of neural activation in response to stress.

For example, many theorists have posited that individuals who are at high risk for the onset of an emotional disorder are characterized by negative biases in their processing of environmental information, selectively attending to negative stimuli, and demonstrating better memory for negative than for positive experiences (see APPRAISAL STYLE). These processing biases are hypothesized to maintain negative affective states and hinder recovery from stressful events. Although a large body of literature has documented the operation of these negative cognitive styles in people who are experiencing emotional disorders, most notably *anxiety and depression, only a few investigators have explicitly assessed their role as risk factors for disorder. In

particular, Joormann *et al*. (2007) recently demonstrated that the young offspring of depressed mothers exhibit an attentional bias to negative faces despite not yet having experienced an emotional disorder themselves (see ATTENTION AND EMOTION).

A growing literature is also beginning to elucidate the biological foundations of difficulties in emotion regulation by examining neuroendocrine and neural functioning in response to stressors (see PSYCHONEUROENDOCRINOLOGY). The HPA system is activated when organisms are exposed to stress, producing cortisol as a means of mobilizing the resources necessary to sustain appropriate physical and psychological activity; indeed, investigators have posited that levels of cortisol produced under stress reflect the ability of individuals to regulate and cope (Gunnar *et al*. 1989). It is not surprising, therefore, that atypical cortisol secretion has been found in people experiencing various forms of emotional disorder. Importantly, there is also now evidence that high levels of cortisol production in response to stress may be a risk factor for the development of emotional disorders (e.g. Gotlib *et al*. 2006). Finally, investigators have begun to delineate the neural aspects of emotion regulation and dysregulation. In particular, researchers have implicated relations among medial and dorsolateral prefrontal brain areas and emotion-processing areas, such as the *amygdala and the orbitofrontal cortex, in the regulation of affect. Here, too, investigators are now presenting initial evidence that sustained activation of the amygdala, already found to characterize individuals with depression, may represent a critical risk factor for the experience of emotional disorders (e.g. Gotlib *et al*. 2006).

Although important, this literature is developing in relative isolation. It is clear that we must work to integrate the study of psychological and biological variables in order both to gain a more comprehensive understanding of risk factors and to be able to prevent the onset of debilitating emotional disorders.

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risk-taking Risk-taking generally means taking an action with the possibility of a worse consequence than not taking the action, for example sky-diving with the possibility of death. In the decision literature, risk-taking often refers to choosing an option with probabilistic outcomes over an option with a sure outcome of the same (or higher) expected value; for example, choosing a gamble with a 50% chance of winning $1000 or nothing, over a sure gain of $500 (see DECISION-MAKING). In this sense, risk-taking is one of three types of risk preferences, the other two being risk aversion and risk neutrality. Most existing models of choice under risk explain risk preference in cognitive terms, assuming that decision-makers assess the desirability and probabilities of possible outcomes of choice options and integrate the information multiplicatively to arrive at a decision. Among these models, the best-known descriptive model is Kahneman and Tversky's (1979) prospect theory, according to which people are generally risk-taking when faced with losses and risk averse when faced with gains. More recent research suggests that risk preference is often dictated by the decision-maker's emotional reactions (e.g. fear and anxiety) toward the risks in the decision situation, and such emotional reactions often diverge from cognitive assessments of the risks (e.g. Loewenstein *et al*. 2001, Slovic *et al*. 2001).

CHRISTOPHER K. HSEE AND YANG YANG

rumination Rumination refers to recurrent, profound, and prolonged thinking about matters of personal concern and interest, although there are a number of distinct conceptualizations within this general definition. Within the clinical field, rumination has been conceptualized relatively narrowly as a learnt response style characterized by repetitive thinking about the symptoms, meanings, and consequences of depressed mood (Nolen-Hoeksema 1991). Such depressive rumination is found to be elevated in patients with major *depression and to predict the onset and maintenance of depressed symptoms in prospective longitudinal studies. Experimental manipulations demonstrate that ruminative self-focus exacerbates negative mood and negative thoughts compared with distraction, indicating a causal effect of rumination on mood and cognition. Depressive rumination is found to be elevated in women compared with men, and provides a partial explanation for the 2:1 ratio of depression in women compared with men. Taken together, this evidence suggests that depressive rumination is a key pathological process in the onset and maintenance of depression. Nonetheless, recent research has suggested that even depressive rumination has distinct subtypes, each with distinct functions, some of which can be constructive. The most unhelpful form of rumination is characterized by abstract and evaluative brooding about problems and difficulties, e.g. 'Why do I have problems that other people don't have?'.

More broadly within social cognition, rumination has been conceptualized as recurrent instrumental thinking about an unresolved *goal, which is triggered by a perceived discrepancy between the current state and the desired goal, which focuses on the perceived discrepancy, and which persists until the unresolved goal is achieved or abandoned (Martin and Tesser 1996). Within this definition, rumination has the potential to be constructive or unconstructive, depending, respectively, on whether it focuses on how to reduce the perceived discrepancy through active problem-solving or passively makes the unattained goal more salient.

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